Source Control Evaluation
Willamette Cove Upland Facility
Portland, Oregon

Prepared for:
Port of Portland

February 13, 2013
1056-03

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1.0 Introduction

1.1 Purpose

This report presents the Source Control Evaluation (SCE) for the Willamette Cove Upland Facility (the Facility). This SCE was performed in response to a request by the Oregon Department of Environmental Quality (DEQ) to identify, evaluate, and control sources of contamination that may reach the Willamette River, consistent with the DEQ-U.S. Environmental Protection Agency (EPA) Portland Harbor Joint Source Control Strategy (JSCS; DEQ/EPA, 2005). These activities were performed at the Facility under Voluntary Cleanup Agreement EC-NWR-00-26 (VCP Agreement) between the Port of Portland (Port), Metro, and the DEQ. The Facility is defined in the DEQ Environmental Cleanup Site Information (ECSI) database as ECSI No. 2066.

1.2 Source Control Evaluation Objective

The objectives of the SCE are to: (1) identify potential sources of contamination; (2) evaluate the potential sources identified; and (3) if necessary, recommend controls of potential sources of contamination that may adversely impact the Willamette River.

1.3 Report Organization

This report is divided into six additional sections. Section 2 discusses background information on the Facility, including site use, upland investigations, and available data for sediment near the Facility. Soil and groundwater data are summarized in tables in Appendix A. In Section 3, potentially complete migration pathways from the Facility to the river are identified. Section 4 presents an evaluation of the potential for erosion of the riverbank. Section 5 contains a screening evaluation of soil and groundwater data. For each potentially complete pathway to the river and media containing chemicals above screening levels, Section 6 presents a weight-of-evidence evaluation of the potential for contaminant transport to the river. Results of the SCE are summarized in Section 7.

2.0 Site Background

2.1 Site Description

The Facility is located along the northeast bank of the Willamette River in the St. Johns area of Portland, Oregon. Figure 1 shows the location of the Facility. The Facility is situated between River Miles 6 and 7 on the Willamette River and is mostly in Section 12 of Township 1 North, Range 1 West, Willamette Meridian. The Facility has been owned by Metro since 1996. Figure 2 provides a current plan of the Facility as well as the surrounding area. For purposes of describing the Facility, it has been divided into West, Central, and East Parcels as shown on Figure 2.

The Facility is bordered on the northeast by the Union Pacific Railroad (UPRR) tracks. Farther to the northeast is a vegetated bluff. A residential area is present on top of the bluff and farther inland. Bordering the northwest side of the Facility is a vacated portion of North Richmond Avenue. To the southeast is an embankment for a railroad bridge over the Willamette River for the Burlington Northern Santa Fe (BNSF) railroad. On the opposite side of this embankment is the former McCormick & Baxter Creosoting Company, a federal Superfund Site. The southern portion of the East Parcel of the Facility has been impacted by a contaminant plume (including polycyclic aromatic hydrocarbons [PAHs], semi-volatile organic compounds [SVOCs], dioxins/furans, arsenic, chromium, copper, zinc, pentachlorophenol, and non-aqueous phase liquids [NAPL]) emanating from the McCormick & Baxter Creosoting Company Superfund Site. The McCormick & Baxter contaminant plume has migrated northwestward from McCormick & Baxter's former wood treatment operations, under the railroad embankment, and has emerged in the sediments of Willamette Cove. DEQ, acting on behalf of EPA, has implemented a remedial action consisting of a subsurface barrier wall and sediment cap to address the McCormick & Baxter contaminant plumes and NAPL seeps in Willamette Cove.

Extent of the Upland Facility. The Facility as defined in the VCP Agreement covers approximately 24 acres of upland area that is inland from the mean high water line (defined as 13.3 feet, NAVD88 datum) to the UPRR. The upland portion is approximately 3,000 feet long and varies from 150 to 700 feet in width. The cove is set in up to 800 feet from the main river channel; it was created primarily as a result of the placement of the embankment leading up to the railroad bridge.

Access. The Facility is accessible by vehicle either from North Edgewater Street (for the east end) or North Richmond Avenue (for the west end). A locked gate is present at the north end of Edgewater Street near its intersection with North Willamette Boulevard. Although vehicle access onto the property is limited by vegetation, berms, or fencing, access to the area by foot or from the river is possible.

Surface Features. The majority of the Facility is currently covered with vegetation consisting of grasses, bushes, and trees. Indications of previous structures include a large concrete foundation and a paved roadway in the eastern portion of the Facility, several smaller concrete structures or foundations, and piles within the cove and along the riverbank. Riprap is present along most of the riverbank.

Topography. The Facility is situated on a terrace created by historical filling. Overall, the topography of this terrace is flat, with an elevation ranging between 30 and 45 feet above mean sea level (msl, NAVD88). The southern portion of the West Parcel is slightly higher, at 50 to 55 feet msl. Berms and hummocks are occasionally present. The riverbank is generally a steep 20- to 30-foot slope down to the river. The river water elevation is typically less than 10 feet msl and is subject to a mean tidal range of about 2 feet.

The BNSF railroad embankment along the southeast perimeter of Willamette Cove rises steeply about 50 feet above the cove. North of the property, across the UPRR tracks, is a naturally formed 120- to 150-foot-high bluff. By the Central and East Parcels, this bluff rises at approximately 5H:4V. Near the West Parcel, the slope is approximately 10H:3V.

Groundwater Conditions. Shallow groundwater at the Facility was measured in monitoring wells MW-1 through MW-7 on four occasions (February and May 2002 and August and December 2005). Depth to groundwater ranged from 23 to 37 feet below the ground surface (bgs). Groundwater elevations ranged from 7.2 to 21.5 feet (NAVD88). Groundwater levels are expected to seasonally fluctuate in response to both precipitation and river levels, with lower groundwater elevations expected during the summer and fall. The groundwater gradient beneath the Facility is anticipated to be toward the Willamette River.

2.2 Historical Site Use

West Parcel. The West Parcel was originally developed in 1901 as a plywood mill, and operated as a wood products facility into the 1970s. The property was purchased by the Portland Development Commission (PDC) in 1979. The property has remained vacant since. In 1996, the property was sold to Metro for the purpose of creating a green space area to be used as a public park.

Plywood plants use debarkers to remove bark from logs prior to lathing the veneers, adhesives (glues) to glue the veneers together, and hydraulic presses to press the veneers. Much of the equipment used would include hydraulics. Other ancillary activities include metal work and storage of oils and glues. Features posing a potential environmental concern included a glue mixing and gluing room, presses, debarkers, an oil house, a blacksmith shop, and a grinding room. Additionally, the former log pond was filled about 1973, with fill from an unknown source(s). Features posing a potential concern on the West Parcel included glue storage, fuel tanks, and an underground petroleum pipeline along the railroad track. Possible contaminants from these features are phenol and formaldehyde (from glues); total petroleum hydrocarbons (TPH) and PAHs (from oil use); polychlorinated biphenyls (PCBs; from hydraulics); metals (from grinding); and volatile organic compounds (VOCs; from use of solvents to clean metal).

Central Parcel. The Central Parcel was developed in 1903 in conjunction with the construction of the St. Johns Dry Docks in Willamette Cove. Between 1903 and 1924, shops and ancillary structures that provided support for dry dock activities were constructed. The dry docks were closed in 1953. The western portion of the Central Parcel was sold in 1950 and it was incorporated into the plywood and lumber mill operations on the adjacent West Parcel. The remainder of the Central Parcel was sold in 1953 and developed as a sawmill. The sawmill was demolished in 1970. Up until 1981, portions of the property were used for a variety of purposes such as log rafting, a marine salvage company, a demolition contractor, woodworking facilities, and a boat builder. By 1981, the property was purchased by PDC, and PDC demolished the buildings by 1982. The property has remained vacant since. In 1996, the property was sold to Metro for the purpose of creating a green space area to be used as a public park.

Features posing a potential concern on the Central Parcel included a machine shop, blacksmith shops, an air compressor room, an oil warehouse, a paint shed, a fuel oil standpipe, a debarker, and a saw filing room. Concerns adjacent to the Central Parcel included dry docks, a power house, transformers, and an underground petroleum pipeline along the railroad track. Possible contaminants include TPH, PAHs, metals, VOCs, and PCBs (from transformers and hydraulics).

East Parcel. The East Parcel was historically occupied by a cooperage plant (i.e., wood barrel manufacturer) from 1917 until 1955. Until 1980, a variety of wood-product-related businesses occupied the parcel. PDC purchased the property in 1980 and demolished the buildings by 1982. The property has remained vacant since. In 1996, the property was sold to Metro for the purpose of creating a green space area to be used as a public park.

The cooperage plant would debark logs, cut the wood into staves, dry the staves, cool them, and then make the barrels. Plywood was also made during the 1950s and 1960s. Features posing a potential concern included a machine shop, a grinding room, a saw filing room, an oil house, a transformer house, a battery charging room, a glue mixing and gluing room, and presses. Concerns adjacent to the East Parcel include a debarker, transformer, and an underground petroleum pipeline along the railroad track. Possible contaminants include phenol, formaldehyde, TPH, PAHs, metals, VOCs, and PCBs.

2.3 Current Site Use

The Facility is currently vacant, covered with invasive and native vegetation, and provides habitat for opportunistic use by wildlife. The site is not managed for any human use and is posted to prohibit trespassing. However, trespassers frequent the area (e.g., homeless persons and joggers).

The Facility is currently zoned as an Open Space (OS) zone with “g” (River General) and “q” (River Water Quality) greenway overlay zones (City of Portland, 2004). The Open Space zone is intended to preserve and enhance public and private open, natural, and improved park and recreational areas. Greenway regulations are also intended to protect, conserve, enhance, and maintain the natural, scenic, historical, economic, and recreational qualities of lands along Portland’s rivers. Specifically, the “g” overlay is intended to allow public use and enjoyment of the waterfront and for enhancement of the river’s scenic and natural qualities. The “q” overlay is designed to protect the functional values of water quality resources by limiting or mitigating the impact of development in the 25-foot setback from the top of bank. Other nearby zoning includes commercial (EG2), residential (R2 and R5), open space (OS), and industrial (IH and IG2; City of Portland, 2004).

The Facility is included in a citywide inventory that identified scenic resources at the Facility (City of Portland, 2012). The Facility is identified as a scenic viewpoint. The zoning map shows a recreational trail through the Facility (City of Portland, 2004). However, this trail is only proposed as part of the regional trail plan adopted by Metro (Alta Planning and Design, 2010).

2.4 Upland Investigations

Numerous investigations, assessments, and environmental actions have been performed at the Facility since 1988. The following sections summarize the scope and results of work performed relevant to the SCE. Sample locations are shown on Figures 2 through 4. Data relevant to the SCE are listed in the tables in Appendix A.

2.4.1 Remedial Investigation Soil Sampling

The Port and Metro conducted a remedial investigation (RI) of the Facility between April 2001 and September 2002. The RI activities included completing 26 test pits, 30 push probes, and seven hand-augered soil borings; and collecting 35 surface soil samples. The results of the RI and historical investigations were presented in the RI Report (Hart Crowser, 2003). Soil data from the RI are listed in Tables 1.1 through 1.9 in Appendix A.

2.4.2 Riverbank Sampling

DEQ provided comments on the RI Report in a letter dated December 20, 2003. Several of these comments expressed concern regarding potentially erodible soil on the riverbank at the Facility. In response to these comments, and those received from DEQ in meetings on June 22, 2005 and October 17, 2005, the Port and Metro submitted the *Riverbank Soil Sampling Work Plan* (Blasland, Bouck, and Lee, Inc. [BBL]/Ash Creek Associates, Inc. [Ash Creek]/NewFields [NF], 2005a). The purpose of that work was to assess for the presence and magnitude of PCBs, PAHs, and metals in potentially erodible riverbank soil for incorporation into an SCE for the Facility.

The results of the first phase of riverbank sampling were presented in the *Riverbank Soil Sampling Report* (BBL/Ash Creek/NF, 2006a). That report presents results for samples WC-SSA through WC-SSK. These data are listed in Tables 2.1 through 2.3 in Appendix A.

The Port and Metro conducted sampling to assess the lateral extent of PCBs in the riverbank at the boundary between the East and Central Parcels. The sampling results for additional surface soil samples (WC-SSH-A through WC-SSH-H, WC-SSH-SHS1, and WC-SSH-SHS2) were presented in the *Addendum to Riverbank Soil Sampling Results Report* (Ash Creek/NewFields, 2008). These data are listed in Table 3.1 in Appendix A.

Additional riverbank sampling was completed in accordance with the *Source Control Sampling Work Plan* and the work plan addendum (Ash Creek, 2010a and 2010b). Sample results (WC-SSL through WC-SSY and WC-1 through WC-3) are presented in the *2010 Source Control Sampling Results* (Ash Creek, 2011). These data are listed in Tables 4.1 through 4.3 in Appendix A.

Follow-up sampling of soil in the vicinity of the former wharf road was completed in accordance with the former wharf road sampling plan (Ash Creek, 2012a). Sample results (DU-1, DU2, and DU-3) are presented in the *Surface Soil Sampling Results — Former Wharf Road Area* (Ash Creek, 2012c). These data are listed in Table 5.1 in Appendix A.

2.4.3 Groundwater Sampling

Pre-RI Groundwater Sampling. Investigations conducted prior to the RI included grab groundwater sampling from borings. The results of the historical groundwater investigations were presented in the RI Report (Hart Crowser, 2003). Grab groundwater data from the pre-RI investigations are listed in Tables 6.1 through 6.10 in Appendix A.

Monitoring Well Sampling. As part of the RI for the Facility, seven groundwater monitoring wells were installed (Figure 2) and the wells were sampled twice. In the December 20, 2003 DEQ letter commenting on the RI Report, the DEQ requested additional groundwater monitoring be conducted. The Port and Metro conducted two additional groundwater monitoring events (one during the rainy season and one during the dry season). Groundwater samples were collected from the seven on-site wells. Results of the groundwater monitoring were documented in the RI Report (Hart Crowser, 2003) and two subsequent groundwater monitoring reports (BBL/Ash Creek/NewFields, 2005b and 2006b). Monitoring well data are listed in Tables 7.1 through 7.6 in Appendix A.

2.4.4 Removal Action – Inner Cove (2004)

On July 1, 2004, a petroleum sheen was observed at Willamette Cove during implementation of the remedial action at the McCormick & Baxter site (E&E, 2004). The sheen was observed on the water, in the innermost portion of the cove adjacent to the East Parcel, during the removal of pilings near the shoreline. Test pits were excavated in the area of the sheen on July 8, 2004. One of three test pit locations located directly inland from the Ordinary Line of Low Water (OLLW) indicated the presence of separate-phase petroleum hydrocarbons (SPH) in soil. The soil with petroleum was bounded by a nearby test pit located farther inland and in a third test pit located to the southeast toward the McCormick & Baxter site (Ash Creek, 2005).

DEQ, the Port, and Metro performed a removal action on October 28, 2004 to: (1) investigate the nature and extent of petroleum product along the innermost beach of Willamette Cove; and (2) remove mobile petroleum product inland of the OLLW to the extent practicable through soil excavation. The removal action delineated the extent and successfully removed the mobile petroleum product inland of the OLLW. Approximately 20 tons of soil were disposed of off-site. The test pits and removal action demonstrated that there was not a continuing source to the river from the upland area (Ash Creek, 2005).

2.4.5 Surface Sediment Characterization in Former Wharf Road Area

On September 17, 2007, potholing (i.e., shovel pits) was completed by Ash Creek on the beach in the Former Wharf Road area of the Central Parcel in the vicinity of DEQ observations (August 2007) noting gray silty surface sediment that had an apparent sheen when disturbed or dropped into water. Based on the August 2007 observation and an August 28, 2007 site visit, surface sediment samples were collected from this area. The purpose of the sampling was to better understand the origin of sheens (petroleum, other oily product [e.g., creosote], or naturally occurring organics) observed on water when this gray silty surface sediment was disturbed. Further information on the sheen observations, including the August 28, 2007 site visit, are provided in the *Characterization of Surface Sediment Report* (Ash Creek/Newfields, 2010). In summary, the chemical analysis and forensic evaluation concluded the hydrocarbon concentration the samples is consistent with concentrations observed in urban waterways and that the varying degree of weathering and biomarker patterns suggests that the petroleum was deposited in small quantities over an extended period of time.

2.5 Nearshore Sediment Data

Sampling of sediments has been completed in the cove adjacent to the Facility, and results of the sampling are evaluated in detail in the Portland Harbor RI report.

3.0 Migration Pathways Evaluated

In accordance with the JSCS guidance document (DEQ/EPA 2005; screening criteria revised July 16, 2007), the approach to the SCE includes the identification of each known or potentially complete migration pathway to the river. Potential migration pathways are evaluated in this section. Potentially complete migration pathways are further evaluated in Sections 5 and 6.

3.1 Identification of Migration Pathways

Over-Water Activities. There are no over-water activities at the Facility, so this pathway is not further evaluated.

Stormwater Pathway. There are no stormwater conveyances at the Facility. There are currently no improvements on the Facility. Several potential outfalls have been identified at the Facility. These potential outfalls were evaluated and it has been confirmed that these either are not outfalls draining the Facility or are no longer active (Port and Metro, 2006; Ash Creek, 2012b and 2012d). Therefore, this pathway is not further evaluated.

Stormwater Conveyances as Preferential Groundwater Migration Pathway. This pathway is incomplete. As discussed in Section 2.1, depth to groundwater at the Facility ranged from 23 to 37 feet bgs as measured in monitoring wells. This is greater than the depth of potential historical stormwater conveyance lines. The depth of the City of Portland outfall (OF49) is not known, but this single outfall is unlikely to have a substantive impact on groundwater discharge, if any. Therefore, this pathway is incomplete and is not further addressed in this SCE.

Riverbank Erosion Pathway. The riverbank may be subjected to erosive forces from river currents, wind waves, and boat wakes. If erodible soil and chemical constituents are co-located in soil on the riverbank, these have the potential to migrate to the river or cove. The riverbank erosion pathway is carried forward for further evaluation.

Groundwater Pathway. Groundwater at the Facility is presumed to flow toward the Willamette River. Constituents present in groundwater, if any, therefore have the potential to migrate to the river. This pathway is carried forward for further evaluation.

3.2 Summary of Migration Pathways Evaluated

The riverbank erosion and groundwater pathways are carried forward for evaluation in this SCE. The other potential migration pathways are incomplete. Evaluation of the riverbank pathway includes potential for erosion of the riverbank (Section 4), screening of historical chemical data in riverbank soil (Section 5.2), and a weight-of-evidence evaluation of the potential for migration of chemicals to the river at concentrations above levels of concern (Section 6.1). Evaluation of the groundwater pathway includes screening of historical chemical data (Section 5.3) and a weight-of-evidence evaluation of the potential for migration of chemicals to the river at concentrations above levels of concern (Section 6.2).

4.0 Riverbank Erosion Evaluation

This section presents an analysis of the potential for erosion of the Facility riverbank. The analysis included the following elements:

- Assessing the overall stability of the existing riverbank;
- Conducting a visual reconnaissance of the riverbank; and
- Assessing potential for erosion of the bank from river action.

4.1 Slope Stability Assessment

Stability of the riverbank at the Facility was qualitatively assessed by comparing overall slope steepness to slope configurations generally considered susceptible to slope movement.

Based on topography as depicted on Figure 2, the eastern two-thirds of the Central Parcel and the entire East Parcel have riverbank slopes of 2H:1V or flatter. Historically, these areas were primarily engineered slopes including riprap protection (Central Parcel) or areas with flat slopes covered by buildings (East Parcel). Slopes of 2H:1V are common in developed areas throughout Portland Harbor and are generally not susceptible to slope movement.

The western third of the Central Parcel has slopes varying between approximately 0.5H:1V to 1.3H:1V. The portion of the slope that is 1H:1V or steeper comprises the western 400 feet of the Central Parcel. The West Parcel generally has slopes near 1H:1V with portions of the slope as steep as 0.7H:1V. The steepness of the slopes in these areas indicates potential for slope movement.

4.2 Riverbank Reconnaissance

On September 4 through September 6, 2012, Ash Creek completed visual reconnaissance of the Facility riverbank. Figures 5 through 7 show the results of the visual mapping, identifying geomorphic features and surface cover. Photographs documenting the observations are included in Appendix B. Photograph locations are shown on Figures 5 through 7.

West Parcel. The riverbank is relatively steep, heavily armored, and covered with thick vegetation. Because of the thick vegetation, the riverbank could not be safely accessed by foot. On November 21, 2005, a visual reconnaissance of the riverbank was conducted from a boat. No areas of erosion or bare soil were observed (Port and Metro, 2006).

Central Parcel. The following discussion of the Central Parcel is referenced to the stationing shown on Figures 5 and 6.

- Station “C” 0+00 to 3+50. The riverbank on the western edge of the Central Parcel is characterized by a relatively flat sandy beach area, bordered by a steep bank at and above the Ordinary High Water Line (OHWL – identified based on visual assessment of the location where predominantly upland vegetation was present), and near complete riprap armoring between the beach and the water (Photographs 1 and 2). The bank near and above the OHWL includes an erosional scarp feature near the top of the slope with colluvium at the base of the scarp (Photograph 3). The scarp extends nearly the full length of this section and varies from 10 to 15 feet high (from the beach to the top of slope). The area above the scarp is densely vegetated with grasses, bushes, shrubs, vines, and larger trees (Photograph 4). The colluvium is covered in moderately dense vegetation, including grasses, bushes, and small trees. The sandy beach area is generally void of vegetative cover.

- **Station "C" 3+50 to 5+90.** The riverbank in this area is generally characterized by the presence of riprap armoring below the OHWL and a densely vegetated upper bank (Photographs 5 and 6). Two scarp features (a western scarp and an eastern scarp) were observed in the riverbank of this area. The western scarp is a continuation of the scarp observed between Stations 0+00 and 3+50. The eastern scarp is above the OHWL, approximately 80 feet in length, and roughly 15 feet high along the scarp face. Below the eastern scarp, patches of sand are present in the riprap (Photograph 6).

- **Station "C" 5+90 to 9+70.** This section of the riverbank consists of a generally uniform slope with riprap armoring on the lower portion (below the OHWL) and vegetation on the upper portion (above the OHWL). Vegetation consists of dense grasses, bushes, vines, and trees. A wooden bulkhead formed from closely spaced piling is present at the toe of the riprap slope in this area (Photograph 7; Figure 5). There were no erosional features observed in this area.

- **Station "C" 9+70 to 19+30.** The riverbank along the eastern half of the Central Parcel consists of a generally uniform slope with mostly intact riprap armoring on the lower portion (below the OHWL) and vegetation on the upper portion (above the OHWL). Vegetation consists of dense grasses, bushes, vines, and trees. Several small scarp features were identified along this portion of the riverbank above the OHWL (Photographs 8, 9, and 12). The riprap includes occasional larger concrete debris (Photograph 10). Scattered patches of sand are present in the riprap (Photograph 11). In general, the erosion features are small (scarps are less than 40 feet in length and 5 to 10 feet in height, or less) and discontinuous, with the majority of the riverbank appearing to have intact riprap armoring and dense vegetation (Photograph 13).

East Parcel. This area is characterized by a large relatively flat beach area bordered by steeper banks and dense vegetation above the OHWL. The following discussion of the East Parcel bank above the beach is referenced to the stationing shown on Figure 7.

- **Station "E" 0+00 to 1+50.** The bank in this area features two scarps. A relatively small scarp extends on the parcel from the Central Parcel (Photograph 14). A larger scarp, approximately 90 feet long and 5 to 15 feet in height, is present toward the top of the bank. The slope beneath the scarp is partially armored with riprap and large concrete debris (Photograph 15). Vegetation on the bank generally consists of grasses, bushes, vines, and trees, mostly observed above the scarp face.

- **Station "E" 1+50 to 4+40.** The bank in this area is not as high as other areas of the Facility, and the bank is reinforced with large concrete blocks (Photograph 16 and 18). A patch of bare soil is present in the middle of this area (Photograph 17).

- Station "E" 4+40 to 9+60. This area features an articulated block armored cap on the beach area with vegetation or large riprap at the upper edge of the cap (Photographs 19, 21, 22, and 23). A scarp is present extending 220 feet south from a concrete structure at the base of the BNSF embankment (Photographs 20 and 21). The scarp is covered in dense vegetation, including bushes, vines, and large trees. The toe of the scarp has been covered with riprap (Photograph 22). The scarp face varies in height from approximately 15 to 20 feet high (from the toe of the riprap to the top of the scarp). The presence of riprap at the scarp toe and vegetation on the scarp suggest that the scarp is no longer actively eroding.

4.3 Assessment of Potential for Erosion from River Action

Erosion from river action has two primary components: (1) bed shear resulting from the natural motion of the flowing water; and (2) wave action caused primarily from boat wakes.

Bed Shear. Figure 8 presents bed shear estimates at the Facility adapted from modeling conducted as part of the Portland Harbor RI/FS Comprehensive Round 2 Report. The Facility is located on the north side between River Mile 6.4 and 6.9. Under both the high-flow and low-flow scenarios, bed shear is at the lowest modeled level except for the western end of the Central Parcel and the West Parcel. Under both scenarios, but especially under the high-flow scenario, bed shear is relatively higher at the west end of the Facility (e.g., modeled bed shear is 20 times greater at the west end of the Facility than within the cove). These results suggest that erosion of the bank from natural river flow is possible at the west end of the Facility under high-flow conditions.

Wave Action. In general, waves impacting unprotected riverbank may cause soil erosion depending on such factors as soil type, slope steepness, and wave height. The riverbank below the OHWL is generally covered with riprap. The vast majority of the riverbank above the OHWL is generally covered with dense grasses/vegetation. These surface covers are typically sufficient to withstand erosion from wave action. Portions of the riverbank, however, have visible erosion scarps or bare soil. When the river level is near the elevation of the erosion scarp or bare soil (which is relatively infrequent because the scarps are typically at or above the OHWL), wave action could cause erosion.

4.4 Summary of Riverbank Erosion

Figure 9 summarizes the multiple lines of evidence evaluated for potential for erosion of the Facility riverbank, demonstrating that the majority of the riverbank is stable and not subject to erosion. Features identified on the figure are steep riverbanks, locations where bed shear from river flow is elevated relative to low-flow conditions, and locations where bare soil or scarps were observed. The following summarizes the overall potential for erosion of the riverbank at the Facility.

West Parcel. The West Parcel has low potential for erosion or bank movement. Although the riverbank is relatively steep and the shoreline is subject to relatively high bed shear during high-flow conditions, the riverbank is heavily armored and covered with thick vegetation. Furthermore, the riverbank location has been unchanged since it was constructed more than 30 years ago.

Central Parcel. There is potential for erosion of the riverbank in the Central Parcel, summarized as follows.

- **West End.** The western 300 feet of the Central Parcel riverbank exhibits evidence of erosion including oversteepened slopes and exposed bare soil and scarps. The erosion is likely associated with river action, primarily river currents, but exposed soil would also be subject to erosion from boat wakes, depending on the river level. The next 300 feet of riverbank to the east exhibits several areas of bare soil and scarps.
- **East Half.** The eastern 1,000 feet of the Central Parcel riverbank has scattered areas of bare soil and scarps. These areas are in the more protected portion of Willamette Cove so would be subject to erosion primarily from boat wakes when the river levels correspond to the bare areas or scarps. Given that the scarps are generally above the OLHW, erosion events would be limited to periods of higher water so would be infrequent. The riverbank is relatively less steep so has low potential for bank movement.

East Parcel. The East Parcel riverbank has scattered areas of bare soil and scarps. These areas would be subject to erosion primarily from boat wakes when the river levels correspond to the bare areas or scarps. A relatively high scarp present along the BNSF embankment has large riprap at the toe and significant vegetation growth, suggesting that this scarp is no longer actively eroding.

5.0 Upland Data Screening

Riverbank soil and groundwater data were collected and screened using the following steps: (1) contaminants of interest (COI) were identified by DEQ based on the upland RI and sediment sampling; (2) additional soil sampling was conducted on the riverbank and samples analyzed for COI; (3) riverbank soil data and groundwater monitoring well data were compared to JSCS screening level values (SLVs); and (4) the locations of samples exceeding SLVs were identified.

In comparing soil and groundwater data to the JSCS SLVs, the ratio between the detected concentration and the SLV is defined as the enrichment ratio (ER). An enrichment ratio of one or less indicates that the detected concentration did not exceed the SLV and it is presumed that there is not a source control concern. As described in the JSCS Guidance, an ER greater than one does not necessarily indicate the upland source of contamination poses an unacceptable risk to human or ecological receptors. Potential risks that a COI with ERs greater than one pose to the Willamette River are further assessed using the weight-of-evidence approach presented in Section 6.

5.1 Chemicals of Interest

The historical research conducted for the RI and supplemental sampling identified past activities and features that were identified as potential areas of concern as contaminant sources on the Facility. The potential areas of concern were investigated in the RI and subsequent sampling. Additionally, extensive sediment sampling was conducted adjacent to the Facility as part of the Portland Harbor RI, and those results are compiled in the Portland Harbor RI report. COI were identified considering both nearshore sediment data and upland potential sources as discussed in the following sections.

5.1.1 Nearshore Sediment COI

Constituents present in river sediments adjacent to the Facility at concentrations exceeding EPA Focused Preliminary Remediation Goals (PRGs) were retained as COI because cleanup levels for in-water sediment have not yet been developed. Constituents present in sediments adjacent to the Facility at concentrations above EPA Focused PRGs are summarized as follows:

- Metals, including copper, lead, mercury, and zinc;
- PCBs;
- Benzo(a)pyrene (and other PAHs as benzo(a)pyrene-equivalent);
- SVOCs, including benzyl alcohol and 4-methylphenol; and
- Pesticides, including gamma-hexachlorocyclohexane (gamma-HCH or lindane) and DDT.

5.1.2 Soil Data

Based on the historical site use information, soil samples were collected for the upland RI for analyses of TPH, metals, PAHs, PCBs, pesticides, dioxins/furans, phenols, phthalates, SVOCs, and VOCs (see Section 2.4). Based on results of the RI and subsequent sampling, the DEQ identified metals, PAHs, PCBs, pesticides, butyltins, and dioxins/furans as COI for riverbank soil (Ash Creek, 2010a).

5.1.3 Groundwater Data

During the several phases of sampling leading up to the RI, grab groundwater samples were collected at the Facility. On the order of 20 to 40 grab samples of groundwater from soil borings were analyzed for VOCs, SVOCs, phthalates, phenols, TPH, pesticides/herbicides, PCBs, PAHs, and metals.

Seven groundwater monitoring wells were installed as part of the RI (MW-1 through MW-7). In addition, one monitoring well installed as part of the McCormick & Baxter site investigation (MW-35s) was sampled for investigation of the Facility. MW-35s was sampled once, in 1999. MW-1 through MW-7 were sampled four times – twice in 2002 and twice in 2005. Monitoring well samples were analyzed for COI based on detections in the grab groundwater sampling. COI included VOCs, SVOCs, phthalates, phenols, TPH, pesticides, PCBs, PAHs, and metals (Hart Crowser, 2003).

5.2 Riverbank Soil Data Screening

Soil samples collected from the riverbank and within approximately 20 feet of the top of the bank were used to screen the riverbank erosion pathway. Figures 3 and 4 show the locations of the soil samples included in the screening. Tables 1.1 through 5.1 in Appendix A present the soil data screened for the riverbank erosion pathway (the RI data tables in Appendix A include upland data far from the riverbank that were not included in the riverbank soil evaluation). In addition, to allow data sorting, riverbank data are included as Table A-1 on a CD in Appendix A. Results of the data screening are summarized below for each COI group.

Metals. Up to 13 metals were analyzed in 42 to 47 samples collected from the Facility riverbank. The following summarizes the results of the screening.

- Beryllium and thallium do not have JSCS SLVs.
- Selenium was not detected above the SLV.
- Antimony, cadmium, chromium, and silver were detected above SLVs in one to four samples (out of 44 to 47 samples) at maximum ERs ranging from 1.3 to 3. Average ERs were 0.4 or less.
- Arsenic, nickel, and zinc were detected above SLVs in 10 to 21 out of 47 samples at maximum ERs ranging from 4 to 6. Average ERs ranged from 0.9 to 1.3.
- Copper, lead, and mercury were detected above SLVs in 21 to 43 out of 47 samples at maximum ERs ranging from 140 to 240. Average ERs ranged from 12 to 30.

Samples with copper, lead, and/or mercury above the SLV are from samples located throughout the Central and East Parcels, and locations of higher relative concentrations of these metals do not correlate. For example, the maximum copper ER is from a sub-sample for WC-SSL1 on the East Parcel, the maximum lead ER is from a sub-sample for WC-SSS in the middle of the Central Parcel, and the maximum mercury ER is a sub-sample for WC-SSP at the east end of the Central Parcel.

Butyltins. Six composite samples were analyzed for butyltins. Butyltins were not detected.

PAHs. Forty samples were analyzed for PAHs. The following summarizes the results of the screening.

- Two of the analyzed PAHs do not have JSCS SLVs.
- Five PAHs were not detected above the SLV.

- Nine PAHs were detected above SLVs in one to five out of 40 samples at maximum ERs ranging from 1.3 to 9. Average ERs were 0.8 or less.
- Three PAHs (acenaphthylene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene) were detected above SLVs in six to 17 out of 40 samples at maximum ERs ranging from 15 to 52. Average ERs ranged from 1.0 to 5.1.

Samples with PAH ERs in the range of 1 to 4 were encountered at scattered locations on the Central Parcel (e.g., WC-SSC and WC-SSE at the west end; SS-16 in the middle; SS-28 at the east end) and at WC-SSL1 on the East Parcel. Samples with PAH ERs greater than 4 were encountered only in samples collected in the vicinity of WC-SSP.

PCBs. Thirty-seven samples were analyzed for PCBs. SLVs are available for Aroclors 1016, 1248, 1254, and 1260 and for total PCBs. The following summarizes the results of the screening.

- Aroclors 1016, 1248, and 1254 were not detected above the SLVs.
- Aroclor 1260 was detected above the SLV in five out of 37 samples at a maximum ER of 9. The average ER was 0.6.
- Total PCBs were detected above the SLV in 10 out of 37 samples at a maximum ER of 4,700. The SLV for total PCBs is below the detection limit, so any detection results in an exceedance of the SLV. The average ER was 320.

Samples with detected concentrations of PCBs were located at the west end of the East Parcel (9 of 10 detected concentrations of PCBs were associated with WC-SSH and the samples collected around WC-SSH to define the extent of PCBs in this area) and the west end of the West Parcel (WC-SSA).

Pesticides. Three samples were analyzed for organochlorine pesticides. Pesticides were not detected in a discrete sample from the East Parcel. In two composite samples collected from the railroad embankment on the East Parcel, pesticides were not detected except for DDT, DDD, and DDE. ERs for total DDX (sum of the various isomers) were 49 and 110 for the two composite samples. The discrete samples making up the composite were also analyzed with results up to approximately six times higher in the discrete samples relative to the composite samples.

Dioxins/Furans. Six samples from the former wharf road area (see Figure 4) were analyzed for dioxins/furans. Multiple congeners were detected above SLVs, including six congeners detected above SLVs in four to six out of six samples. Because of the extremely low SLVs for some congeners, any detection will result in an exceedance of the SLV. Maximum ERs ranged from 100 to 530,000 and average ERs ranged from 22 to 95,000.

Soil Summary. The following COI should be further considered in the weight of evidence evaluation in Section 6.

- Lead, mercury, and copper at the Central and East Parcels.
- PAHs at the Central Parcel.
- PCBs at the west end of the West Parcel and the west end of the East Parcel. Samples from 22 locations were analyzed for PCBs (multiple samples were analyzed at some locations – e.g., composite and subsamples of the composite). PCBs were detected at only two locations: sample WC-SSA and WC-SSH.
- DDX at the railroad embankment on the East Parcel.
- Dioxins/furans at the former Wharf Road area in the Central Parcel.

5.3 Groundwater Data Screening

In this section, groundwater monitoring well data (used as a surrogate for groundwater potentially entering surface water) are screened to assess groundwater as a potential source to sediments and surface water. Figure 2 shows the locations of monitoring wells at the Facility. Tables 7.1 through 7.6 in Appendix A present the groundwater data. In addition, to allow data sorting, groundwater data are included as Table A-2 on a CD in Appendix A. For the monitoring well sample data set, metals, PAHs, and VOCs were detected at least once above JSCS SLVs. Results of the data screening are summarized below for each of these COI groups.

Metals. Groundwater samples were analyzed for both total (unfiltered) and dissolved (filtered) metals. Screening results are summarized as follows.

- For total analyses, 10 metals were detected at concentrations exceeding groundwater SLVs. Exceedance frequencies varied from three out of 54 samples (cadmium) to 40 out of 54 samples (arsenic).
- For dissolved analyses, five metals were detected at least once above SLVs:
  - Cadmium, copper, and lead were each detected above the SLV once out of 26 samples. The single exceedance for each of these metals was for the February 2002 sampling event from MW-6. For the three events thereafter, these metals were not detected.
  - Selenium was detected above the SLV in four out of 26 samples. The ERs ranged from 1.1 to 1.6. The exceedances were from the 2002 sampling events from MW-1 and MW-3. For the subsequent two events in 2005, concentrations were below the detection limit or the SLV.
  - Arsenic was detected above the SLV in 12 of 26 samples. Arsenic was not detected in MW-4 and MW-5, and was detected in only one of four samples from MW-6. In the remaining four monitoring wells, (MW-1 through MW-3 and MW-7), the arsenic ERs ranged from 23 to 690.

PAHs. Samples from MW-1 through MW-6 were analyzed for PAHs. PAHs were not detected in MW-5 or MW-6. PAHs were detected above SLVs in MW-1 through MW-4, summarized as follows.

- MW-1: maximum ER for individual PAHs ranged up to 71 and the average ER was 8.
- MW-2: maximum ER for individual PAHs ranged up to 4,700 and the average ER was 140. The primary driver of the higher ERs is naphthalene.
- MW-3: maximum ER for individual PAHs ranged up to 60 and the average ER was 9.
- MW-4: maximum ER for individual PAHs ranged up to 10 and the average ER was 2.

VOCs. Chlorobenzene was detected in MW-2 in two monitoring events at ERs of 1.3 and 1.7. No other VOCs were detected above the SLVs.

Groundwater Summary. For groundwater, PAHs and arsenic should be further considered in the weight of evidence evaluation in Section 6, as summarized by parcel below.

- West Parcel – Arsenic and PAHs were detected in the three monitoring wells on the West Parcel (MW-1 through MW-3). Dissolved arsenic concentrations ranged from 1 to 31 micrograms per liter (µg/L; ERs of 24 to 690). Excluding naphthalene, PAHs were detected at concentrations up to 22 µg/L (ER up to 110), and the average concentration of individual PAHs in these wells was less than 1 µg/L (average ER of 8). Naphthalene was detected in MW-2 at concentrations of 9 to 950 µg/L (ER of 50 to 4700).
- Central Parcel – Arsenic was not detected in MW-4 and MW-5, and it was detected in only one of four events in MW-6 at a concentration of 2 µg/L. PAHs were not detected in MW-5 and MW-6. PAHs were detected in MW-4 at concentrations up to 0.3 µg/L (maximum ER of 10 and an average ER of 2).
- East Parcel – Arsenic was not detected in two of the four events from MW-7. In the other two events, arsenic was detected at 12 and 14 µg/L (ER of approximately 300). PAHs were not detected in the one sampling event on the East Parcel (MW-35s).

6.0 Source Control Evaluation

This section presents a detailed evaluation of potential sources to the Willamette River from the Facility. For the COI and each potentially complete pathway to the river, a weight-of-evidence evaluation is presented below based on applicable site-specific factors listed in Sections 5.1.2 and 5.2 of the JSCS guidance.

6.1 Riverbank Erosion Pathway

Section 4 presented a detailed evaluation of the potential for erosion of the Facility riverbank, as summarized in Section 4.5. Riverbank soil data were screened in Section 5.2. Combining results from the erosion evaluation and the soil screening, the following presents the weight-of-evidence evaluation of the riverbank erosion pathway.

6.1.1 West Parcel

The West Parcel has low potential for erosion. Although the riverbank is relatively steep and the shoreline is subject to relatively high bed shear during high-flow conditions, the riverbank is heavily armored and covered with thick vegetation. Furthermore, the riverbank location has been unchanged since it was constructed more than 30 years ago. Because there is no current or reasonably likely complete contaminant pathway to the river via soil erosion, the West Parcel is an excluded site (as defined by JSCS, a site that does not require source control) for the riverbank erosion pathway.

6.1.2 Central Parcel

Figure 10 summarizes the results of the erosion evaluation and the data screening. The following presents the weight of evidence evaluation for the Central Parcel from west to east, referencing to station locations shown on Figure 10.

- Station "C" 0+00 to 3+50. This area exhibits evidence for potential riverbank erosion, including oversteepened slopes and exposed bare soil and scarps. However, only mercury and PAHs were detected above SLVs, and maximum ERs were 3 and 1.5, respectively. Therefore, the riverbank in this area is a low priority site and no further source control efforts are recommended.
- Station "C" 3+50 to 5+90. There is potential for erosion of the riverbank in this area as demonstrated by observed erosion scarps and areas of bare soil. The primary erosion mechanism would be river action (both bed shear and wave action). Upland areas have no impervious surfaces and are relatively well vegetated, so stormwater runoff is not an erosion mechanism of concern. The scarps are relatively high on the bank, so erosion events would be limited to periods of higher water levels. Lead, copper, and mercury are present above SLVs in this area at maximum ERs of 40, 23, and 9, respectively. Lead and mercury are bioaccumulative, but the ER for mercury is less than 10. Lead, mercury, and copper are not present above EPA Focused PRGs in immediately adjacent sediment. Given the complete erosion pathway to the river and the presence of metals above SLVs, the riverbank in this area is a medium priority site. However, based on the following multiple lines of evidence, it is recommended that source control actions in this area be incorporated into the final in-water remedy design and implementation:
    - The potential for erosion events would be limited to higher water conditions so would be infrequent;

- Relatively few COI are present in riverbank soil, and maximum ERs are 40 or less; and
- COI present in riverbank soil are not present in immediately adjacent sediments above EPA Focused PRGs.

- Station "C" 5+90 to 9+70. This area has low potential for erosion. This area is not subject to high bed shear. The riverbank is armored, covered with thick vegetation, and the toe is protected by a wooden bulkhead. Furthermore, the riverbank location has been unchanged since it was constructed more than 70 years ago. Because there is no current or reasonably likely future complete contaminant pathway to the river, this area is an excluded site.
- Station "C" 9+70 to 12+40. There is limited potential for erosion of the riverbank in this area as demonstrated by scattered, small observed erosion scarps and areas of bare soil. The riverbank is a generally uniform slope with mostly intact riprap armoring on the lower portion and vegetation on the upper portion. The primary erosion mechanism would be wave action. This area is relatively well protected from bed shear. Upland areas have no impervious surfaces and are relatively well vegetated so stormwater runoff is not an erosion mechanism of concern. The scarps are relatively high on the bank so erosion events would be limited to periods of higher water levels. Lead and mercury are present above SLVs in this area at maximum ERs of 43 and 34, respectively. Lead and mercury are bioaccumulative. Lead and mercury are not present above EPA Focused PRGs in sediments immediately adjacent to this area. Based on the following multiple lines of evidence, the riverbank in this area is a low priority site and no further source control efforts are recommended:
  - Evidence of erosion is limited to scattered small scarps and areas of bare soil;
  - The riverbank is armored or covered with vegetation;
  - The potential for erosion events would be limited to higher water conditions so would be infrequent;
  - Relatively few COI are present in riverbank soil, and maximum ERs are 43 or less; and
  - COI present in riverbank soil are not present in immediately adjacent sediments above EPA Focused PRGs.
- Station "C" 12+40 to 15+70. This area shows limited evidence for potential riverbank erosion as demonstrated by scattered, small observed erosion scarps and areas of bare soil, and the riverbank is a generally uniform slope with mostly intact riprap armoring on the lower portion and vegetation on the upper portion. Only mercury and PAHs were detected above SLVs, and maximum ERs were 2 and 1.3, respectively. Therefore, the riverbank in this area is a low priority site and no further source control efforts are recommended.
- Station "C" 15+70 to 17+60. The riverbank in this area consists of a generally uniform slope with intact riprap armoring on the lower portion and vegetation on the upper portion. Vegetation consists of dense grasses, bushes, vines, and trees. There were no observed indications of

erosion. Furthermore, the riverbank location has been unchanged since it was constructed more than 30 years ago. Because there is no current or reasonably likely complete contaminant pathway to the river, this area of the riverbank is an excluded site.

- Station "C" 17+60 to 19+30. There is limited potential for erosion of the riverbank in this area as demonstrated by scattered, small observed erosion scarps and areas of bare soil. The riverbank is a generally uniform slope with mostly intact riprap armoring on the lower portion and vegetation on the upper portion. The primary erosion mechanism would be wave action. This area is relatively well protected from bed shear. Upland areas have no impervious surfaces and are relatively well vegetated, so stormwater runoff is not an erosion mechanism of concern. The scarps are relatively high on the bank so erosion events would be limited to periods of higher water levels. Dioxins/furans, mercury, and lead are present above SLVs in this area at maximum ERs of 530,000, 79, and 41, respectively. These COI are bioaccumulative. Given that an erosion pathway to the river is potentially present and bioaccumulative COI above SLVs are present, the riverbank in this area is a medium priority site. However, based on the following multiple lines of evidence, it is recommended that source control actions in this area be incorporated into the final in-water remedy design and implementation:
  - Evidence of erosion is limited to scattered small scarps and areas of bare soil;
  - The riverbank is armored or covered with vegetation;
  - The potential for erosion events would be limited to higher water conditions so would be infrequent; and
  - Dioxins/furans have the highest relative ER, but are not present above EPA Focused PRGs in sediment immediately adjacent to this area. Lead and mercury, with lower relative ERs, are present above EPA Focused PRGs in sediment immediately adjacent to this area (e.g., compare the results for riverbank sample WC-1/2/3 to the beach sample Wharf Beach-1; see Table 5.1 in Appendix A). These results suggest that erosion is not the mechanism responsible for the presence of COI in sediments in this area.

6.1.3 East Parcel

Figure 10 summarizes the results of the erosion evaluation and the data screening. The following presents the weight of evidence evaluation for the East Parcel from west to east, referencing to station locations shown on Figure 10.

- Station "E" 0+00 to 1+50. There is potential for erosion of the riverbank in this area as demonstrated by observed erosion scarps. There is riprap armoring on the lower portion and vegetation on the upper portion of the riverbank. The primary erosion mechanism would be wave action. This area is well protected from bed shear. Upland areas have no impervious surfaces and are relatively well vegetated so stormwater runoff is not an erosion mechanism of concern. The scarps are relatively high on the bank, so erosion events would be limited to periods of higher water levels. PCBs, bioaccumulative COI, are present above SLVs in this area at a maximum ER of 4,700. PCBs are present above EPA Focused PRGs in sediments immediately adjacent to this area. Given that an erosion pathway to the river is potentially present and the presence of COI above SLVs, the riverbank in this area is a medium priority site. However, based on the following multiple lines of evidence, it is recommended that source control actions in this area be incorporated into the final in-water remedy design and implementation:

  - This area is relatively small and in a protected portion of the cove;
  - The riverbank is generally armored or covered with vegetation; and
  - The potential for erosion events at the scarps would be limited to higher water conditions so would be infrequent.

- Station "E" 1+50 to 4+40. This area shows limited evidence for potential riverbank erosion as demonstrated by a single observation of bare soil, and the riverbank is reinforced with large concrete blocks. Only lead was detected above the SLV at a maximum ER of 2. Therefore, the riverbank in this area is a low priority site and no further source control efforts are recommended.
- Station "E" 4+40 to 9+60. The riverbank in this area consists of an articulated block armored cap on the beach area with vegetation or large riprap at the upper edge of the cap. Vegetation consists of bushes, vines, and trees. A scarp is present on the railroad embankment above the cap. There were no other observed indications of erosion. The presence of riprap at the scarp toe and vegetation on the scarp suggest that the scarp is no longer actively eroding. Because there is no current or reasonably likely complete contaminant pathway to the river, this area of the riverbank is an excluded site.

6.2 Groundwater Pathway

The screening of the groundwater monitoring well samples (Section 5.3) identified arsenic and PAHs above JSCS groundwater/surface water/storm water SLVs. Based on the following weight-of-evidence evaluation, groundwater at the Facility is a low priority for source control and no further source control efforts are recommended.

<u>Arsenic:</u>

- The arsenic concentrations detected in groundwater at the Facility represent background concentrations based on the following.
  - Arsenic in soil is within the background range of arsenic. Dissolved arsenic was detected in groundwater monitoring wells MW-1 through MW-4 and MW-7. Twenty-four soil samples collected within 300 feet of these wells were analyzed for arsenic. The concentrations ranged

from less than 0.5 milligrams per kilogram (mg/kg) to 5.4 mg/kg. This concentration range is less than DEQ's default background concentration of 7 mg/kg.

  - Detected concentrations of arsenic in groundwater are within the range of natural concentrations of arsenic in groundwater within the Willamette Basin. A report prepared by the United States Geological Survey (Hinkle and Polette, 1999) found concentrations of arsenic within the Willamette Basin to range from <1 to 2,000 μg/L with 22 percent of the samples greater than 10 μg/L. Dissolved arsenic concentrations in wells at the Facility ranged from <1 to 31 μg/L.

- Arsenic does not exceed EPA Focused PRGs at Willamette Cove sediments.

<u>PAHs:</u>

- East Parcel: PAHs were not detected.
- Central Parcel: PAHs were not detected in two out of three wells, and ERs were 10 or less in the third well (MW-4).
- West Parcel:
  - Excluding naphthalene, PAHs were detected at concentrations up to 22 μg/L (ER up to 110). The average concentration of individual PAHs in these wells was less than 1 μg/L (average ER of 8). Concentrations of PAHs decreased during the monitoring period: ERs for the final round of monitoring ranged up to 11 in MW-1, 20 in MW-2, and 21 in MW-3.
  - Naphthalene was detected at 950 μg/L (ER of 4700) in the first sampling event in MW-2. Concentrations in MW-1 and MW-3 were 2 to 4 μg/L (ER of 10 to 20). Concentrations dropped 10 to 70 times during the monitoring period. In the final round of sampling, naphthalene was at or below the detection limit in MW-1 and MW-3 (ER of less than 2), and the concentration was 9 to 130 μg/L in MW-2 (depending on the analytical method used; ER of 50 to 670).
  - PAHs were measured in groundwater from wells installed in the upland 70 to 120 feet from the river (i.e., the point of compliance). Some attenuation of the PAHs would be expected to occur prior to discharge to the river.
  - PAHs, as benzo(a)pyrene or benzo(a)pyrene-equivalent, are present in sediment above EPA Focused PRGs immediately adjacent to the West Parcel. However, this corresponds to the area of the former log pond operated on the West Parcel which was filled in the 1970s with fill from an unknown source(s). In addition, naphthalene (the PAH with the highest relative ER in groundwater) was detected in sediments in 14 of 19 samples with a maximum concentration of 720 μg/kg. This corresponds to an ER of only 1.3 when compared to the JSCS SLV.

7.0 Findings and Conclusions

Existing and potential sources to the Willamette River at the Facility were identified and characterized. Upland soil and groundwater sampling were performed under DEQ-approved work plans. Riverbank soil samples were collected from areas identified as having the potential for erosion. Riverbank erosion and groundwater were identified as potential pathways for contaminant transport to the Willamette River. Each pathway was evaluated with the following results.

Riverbank Erosion. The Facility riverbank is approximately 3,500 feet long. Approximately 2,900 feet of the riverbank was determined to be either excluded from need for source control or to be low priority for source control. Areas were excluded because there is no current or reasonably likely complete contaminant pathway to the river. Areas were determined to be low priority because either ERs in riverbank soil were less than three or multiple lines of evidence supported that there is a low potential for that area to contaminate the river. Three areas totaling 560 feet in length were found to be medium priority, summarized as follows (see Figure 10 for Station locations along the riverbank).

- Station “C” 3+50 to 5+90 – This area has relatively greater visual evidence of erosion, and riverbank soil contains lead, copper, and mercury at ERs up to 40, 23, and 9, respectively.
- Station “C” 17+60 to 19+30 – This area has relatively lesser visual evidence of erosion, but riverbank soil contains dioxins/furans, mercury, and lead at ERs up to 530,000, 79, and 41, respectively.
- Station “E” 0+00 to 1+50 – This area has relatively lesser visual evidence of erosion, but riverbank soil contains PCBs at ERs up to 4,700.

Based on multiple lines of evidence, the short-term potential for transport of riverbank soils from these areas to the river is low. Therefore, it is recommended that source control for the medium priority riverbank areas be incorporated into the final remedy for the in-water cleanup.

Groundwater. Groundwater was identified as a low priority for source control and no further source control efforts are recommended. Only arsenic and PAHs were detected above SLVs. Arsenic concentrations are within the range of natural concentrations of arsenic in groundwater within the Willamette Basin, and arsenic does not exceed EPA Focused PRGs at Willamette Cove sediments. For the Central and East Parcels, PAHs were not detected in groundwater or had ERs of 10 or less. PAH concentrations at the West Parcel had higher ERs; however, PAH concentrations showed a strong decreasing trend from the first sampling event to the last. Average concentrations of individual PAHs were less than 1 µg/L with the exception of naphthalene. Naphthalene was at or below the detection limit in two of the three wells in the West Parcel by the final sampling event and generally does not exceed SLVs in adjacent sediment.

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